STATE OF OHIO
DEPARTMENT OF NATURAL RESOURCES
DIVISION OF GEOLOGICAL SURVEY
Horace R. Collins, Chief

Report of Investigations No. 70

STRATIGRAPHY OF SILURIAN AND PRE-OLENTANGY DEVONIAN ROCKS OF THE SOUTH BIRMINGHAM POOL AREA, ERIE AND LORAIN COUNTIES, OHIO

by

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Columbus

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CONTENTS

ILLUSTRATIONS

Figures

TABLES

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INTRODUCTION

Discovery of oil in 1966 in sandstone of the Trempealeau Formation (Cambrian) near Birmingham in Florence Township, Erie County, resulted in about 20 wells being drilled to this sandstone in the Birmingham area and in adjacent Henrietta Township, Lorain County. The discovery well was the Sun Oil Co. #1 Krysik-Wakefield *et al.* unit. The productive area has been designated the South Birmingham Pool (fig. 1).

The purpose of this report is to describe and discuss the stratigraphy of the Silurian and Devonian carbonate rocks (table 1) in the South Birmingham Pool area as a part of a continuing statewide study of this stratigraphic interval. These rocks have been the subject of rather intensive investigation on the outcrop but virtually nothing has been published on their nature in the subsurface.

The present investigation shows that rocks formerly placed in the undifferentiated Lockport Group (Silurian) in the report area can be subdivided and correlated with the Middle Silurian section of southwestern Ontario. In the report area one of these subdivisions, the Guelph Formation, has a biohermal facies which reaches a thickness of more than 90 feet. In the discussion of Devonian rocks the interpretation is offered that the Detroit River Group, rather than having been truncated by the overlying Columbus Limestone (Dow, 1962), has a facies which is indistinguishable from the Columbus Limestone.

Three potentially productive gas or oil zones occur in structural highs within the described section. The highest gas zone occurs within the Columbus Limestone (in the part of the formation erroneously referred to by some drillers as the Oriskany Sandstone). The second gas zone is the Newburg zone, which lies immediately below the lowest anhydrite in the section. The third zone, which contains gas and in which the rocks are heavily stained with oil, is the biohermal facies of the Guelph Formation.

The wells used in this report are listed in table 2. Sample descriptions are listed in the appendix.

SILURIAN SYSTEM

Brassfield Formation

The name Brassfield limestone was used by Foerste (1906, p. 27) for exposures near Brassfield in Madison County, Kentucky. The unit in that locality is approximately 21 feet thick, is overlain by the Plum Creek Clay [Cabot Head Shale], and is unconformably underlain by Ordovician rocks. Rexroad and others (1965, p. 8) changed the name to Brassfield Formation because of the considerable amount of shale and dolomite in the unit.

The Brassfield Formation can be traced from the type section to the report area, where it consists of both fine- to coarse-grained limestone and crystalline dolomite and minor amounts of shale and sandstone. The limestone and dolomite vary in color from light- to medium- to brownish-gray, and are glauconitic, cherty, fossiliferous, and in part bioclastic. Hematite and thin lenses of grayish-green shale and slightly calcareous or dolomitic fine-grained brownish-gray sandstone are found in the upper half of the formation. Silty and argillaceous limestone or dolomite occurs in the basal portion of the formation. The thickness of the Brassfield ranges from 23 to 44 feet and averages about 30 feet.

The lower boundary of the Brassfield is its contact with Upper Ordovician rocks. The contact, generally considered a regional unconformity, is distinct on the gamma ray-neutron log (fig. 2) and is marked in the samples by the change from red shale (Queenston) to carbonate (Brassfield). The Brassfield is transitional with the overlying Cabot Head Shale (fig. 2)

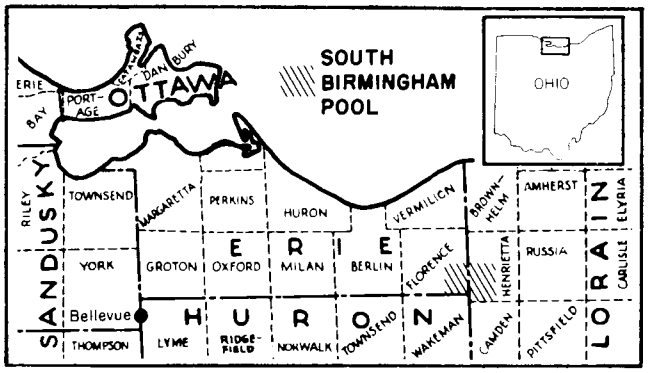

FIGURE 1.–Location map.

and the contact is placed where shale (Cabot Head) dominates over carbonate (Brassfield).

Cabot Head Shale

The name Cabots Head was used by Grabau (1913, p. 460) for red and green shale with an exposed thickness of 150 feet overlying the Keppel (Manitoulin) Dolomite near Cabots Head, Ontario. The formation, now known as Cabot Head, can be traced from southwestern Ontario to the South Birmingham Pool area, where it consists of grayish-green and minor amounts of reddish-brown shale and a considerable amount of interbedded coarse-grained dolomite. The dolomite is hematitic in part. Thin lenses of dense fine-grained gray and brownish-gray sandstone occur in the lower part of the formation and constitute the western featheredge of the "Clinton" sandstones in northern Ohio. Preliminary results of a regional study of the "Clinton" sandstones of Ohio by the writer show that these sandstones occur in a stratigraphic interval equivalent to the Brassfield–Cabot Head interval and that there is a facies relationship between the "Clinton" sandstones of eastern Ohio and the Brassfield Formation and Cabot Head Shale of central Ohio. The thickness of the Cabot Head in the report area ranges from 83 to 115 feet and averages 110 feet.

The Cabot Head is overlain by a coarsely crystalline dolomite. The contact, distinct on the gamma ray-neutron log (fig. 2), can be identified in the samples by the change from shale and dolomite to dolomite.

Unnamed dolomite

A distinctive somewhat sandy medium to coarsely crystalline medium- to dark-gray dolomite overlies the Cabot Head in the South Birmingham Pool area. The unit is 10 to 15 feet thick and is lithologically similar to and occupies the same stratigraphic position as an unnamed limestone (Oldham Limestone?; Foerste, 1906, p. 47) to the south in Adams County, Ohio (unit 3 in section 9 of Rexroad and others, 1965, p. 23). However, with current well control, this dolomite cannot be traced

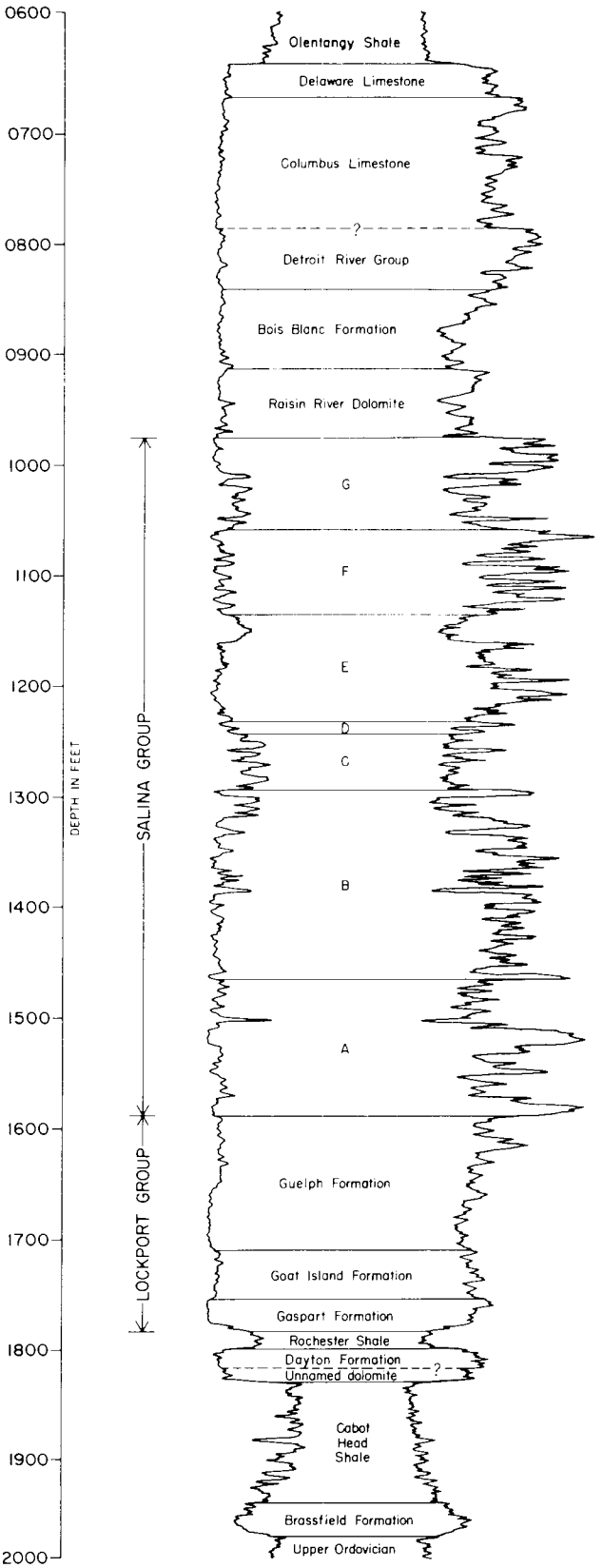

FIGURE 2.–Representative gamma ray-neutron log (Sun Oil Co. #1 Krysik-Wakefield *et al.* unit).

TABLE 1.—*Summary of Silurian and pre-Plum Brook Devonian stratigraphy of the South Birmingham Pool area*

System	Group	Formation	Average thickness (feet)	Description	Contact: Gamma ray-neutron logs	Contact: Samples
Devonian		Olentangy Shale	*	Shale, grayish-green and brownish-gray	distinct	distinct
					disconformity	
		Delaware Limestone	30	Limestone, medium-brown and light-grayish-brown, fine-grained, argillaceous, fossiliferous; containing fossiliferous light- and medium-brown chert	distinct	distinct
					disconformity?	
		Columbus Limestone (Detroit River Group at base)	175	Limestone, light-brownish-gray to yellowish-gray, fine- to coarse-grained, fossiliferous; containing fossiliferous gray and white chert. Fine-grained sandstone or sandy limestone, 3 to 10 feet thick, lies 60 to 70 feet above the base and is believed to mark the top of the otherwise lithologically indistinct Detroit River Group	indistinct	distinct
					regional unconformity	
		Bois Blanc Formation	70	Dolomite, light-brownish-gray, medium-crystalline, sandy, glauconitic, with abundant fossiliferous white and grayish-brown chert	indistinct	distinct
					regional unconformity	
Silurian		Raisin River Dolomite	60	Dolomite, light-gray, brownish-gray, yellowish-brown, microcrystalline, with locally minor amounts of gray or black shale	distinct	distinct
	Salina	G, F, E, D, C, B, A units	670	Dolomite, gray and brown, dense to microcrystalline, argillaceous to very argillaceous in part; interbedded with anhydrite and minor amounts of gray and greenish-gray shale	distinct	distinct
					disconformity?	
	Lockport	Guelph Formation	100-160 (see text)	Dolomite, light-yellowish- to medium-brown, very finely to finely crystalline, changing laterally in the lower part to finely to medium-crystalline light-gray to white dolomite which is vuggy and may represent a biohermal facies	(see text)	
		Goat Island Formation	50	Dolomite, very light-brown to yellowish-brown, finely crystalline, silty; containing fossiliferous white and gray chert	distinct	distinct
		Gasport Formation	28	Dolomite, predominantly bluish-gray, with minor amounts of light- to medium-gray dolomite; both finely to medium-crystalline, granular-looking, and somewhat porous	distinct	distinct
					disconformity?	
		Rochester Shale	18	Shale, gray, greenish-gray, green, dark-brown, dolomitic; containing minor amounts of very argillaceous light- to medium-greenish-gray to brownish-gray dolomite	distinct	distinct
		Dayton Formation	12	Dolomite, light-yellowish-gray to light-yellowish-brown, finely crystalline, slightly glauconitic	indistinct	distinct
		Unnamed dolomite	12	Dolomite, medium- to dark-gray, medium- to coarsely crystalline, slightly sandy	distinct	distinct
		Cabot Head Shale	110	Shale, grayish-green, and minor amounts of reddish-brown shale; interbedded with coarse-grained dolomite that is hematitic in part	indistinct	indistinct
		Brassfield Formation	30	Limestone, fine- to coarse-grained, and dolomite, finely to coarsely crystalline; both light- to medium- to brownish-gray, glauconitic, fossiliferous, cherty; hematitic in upper part; silty and argillaceous near the base; interbedded with grayish-green shale in upper half	distinct	distinct
Ordovician		Queenston Shale	*	Shale, red	*regional unconformity*	

* Only samples adjacent to contacts examined.

TABLE 2.–*Well data*

Permit and map no.	Operator	Well name	Lot	Elevation (ft above sea level)*	Location		
					Quadrangle	Coordinates (10,000 foot grid, Ohio north zone)	
						x	y
	Erie County, Florence Township						
11	Sun Oil Co.	#1 Krysik-Wakefield *et al.* unit	98	828 KB	Kipton	2,041,000	596,400
12	Sun Oil Co.	#1 Schlechter	97	830 KB	Kipton	2,040,900	597,650
14	Sun Oil Co.	#1 Knight *et al.* unit	87	769 KB	Kipton	2,039,600	597,850
15	Sun Oil Co.	#1 Latteman unit	98	833 KB	Kipton	2,041,250	595,325
16	Sun Oil Co.	#1 Hume *et al.* unit	87	828 KB	Kipton	2,039,500	599,175
17	Vaught Oil Co.	#1 Wickens	86	812 KB	Kipton	2,037,800	600,000
18	Glynn Trolz & Assoc., Inc.	#1 Ortner *et al.*	77	824 KB	Kipton	2,037,000	597,950
19	Sun Oil Co.	#1 Herman *et al.* unit	97	830 KB	Kipton	2,040,700	599,100
20	Sun Oil Co.	#1-B Hume	86	817 KB	Kipton	2,039,450	600,500
24	John R. Murphy	#1 Hanko	68	738 DF	Berlin Heights	2,033,050	595,380
25	Tra-Kay Petroleum Co., Inc.	#1 Griffith	54	831 KB	Berlin Heights	2,030,500	606,950
27	Sun Oil Co.	#1 Hunter *et al.* unit	74	809 KB	Kipton	2,036,525	605,925
29	Sun Oil Co.	#1 Hunter-Niemeth *et al.* unit	62	795 KB	Berlin Heights	2,033,950	612,750
30	Sun Oil Co.	#1 Wakefield-Bemis *et al.* unit	98	812 KB	Kipton	2,042,200	596,500
	Lorain County, Henrietta Township						
794	East Ohio Gas Co.	#1 Born	8	850 DF	Kipton	2,049,400	591,200
890	Vaught Oil Co.	#1 Harrison	24	780 KB	Kipton	2,043,550	595,600
892	East Ohio Gas Co.	#1 Reighley	19	834 KB	Kipton	2,055,250	599,780
897	Kennedy Oil Co.	#1 Boy Scouts of America	24	832 DF	Kipton	2,043,280	596,650

* DF Derrick floor
KB Kelly bushing

from the report area to Adams County, either because of a facies relationship with the overlying Dayton Formation or because it is absent between the two areas. The unit is therefore left unnamed until a satisfactory correlation has been established.

The contact between this unit and the overlying Dayton Formation is distinct and is marked in the samples by a change from medium- to dark-gray dolomite to the light-yellowish-brown dolomite of the Dayton. Locally in Lorain County (fig. 3) this dolomite and the Dayton are separated by 5 to 10 feet of shale. Without this shale the contact is indistinct on the gamma ray-neutron log (fig. 2).

Dayton Formation

The term Dayton stone was used by Orton (1871, p. 149) for exposures of about five feet of fine-grained limestone near Dayton in Montgomery County, Ohio. This was later known as the Dayton Limestone, but the name was changed to Dayton Formation (Horvath, 1967) because of the dolomite content of the unit in the subsurface of eastern Ohio. The Dayton Formation can be traced from the type area to the study area, where it is represented by a finely crystalline slightly glauconitic light-yellowish-gray to light-yellowish-brown dolomite having a thickness of 10 to 15 feet. The contact with the overlying Rochester Shale, which is marked by the change from dolomite to gray or green shale, is distinct (fig. 2).

Rochester Shale

Rochester Shale is the name given by Hall (1839, p. 289) to shale exposed in Wayne County, New York, where it underlies Lockport limestone. In the report area the Rochester is a gray, greenish-gray, or green to dark-brown dolomitic shale which in its upper parts contains a minor amount of very argillaceous light- to medium-greenish-gray to brownish-gray dolomite. The thickness of the unit is about 18 feet.

The Rochester is overlain by the Lockport Group. The contact is distinct (fig. 2) and can be identified in the samples by the change from shale or very argillaceous dolomite to crystalline gray dolomite. According to Rittenhouse (1949), an erosional disconformity probably exists at the contact.

Lockport Group

General statement.—The name Lockport was used by Hall (1839, p. 289) for limestone exposed in Lockport, New York, where the unit overlies the Rochester Shale and underlies Salina rocks. This stratigraphic interval in the subsurface of northern Ohio is referred to the Lockport Group (Ulteig, 1964).

Rocks of this group are exposed in western Ohio. Subdivision into formations has been possible in the southern half of the outcrop area, but in the northern half the Lockport consists of massive gray dolomite, vuggy in part, and of a uniformity that has made subdivision into formations impossible. In places the contact with the overlying Salina rocks is exposed, but the lower limit of the uniform dolomite cannot be observed. About 60 feet of Lockport is exposed in many quarries.

In this report the Lockport Group of the South Birmingham Pool area is correlated with the Middle Silurian section of southwestern Ontario (Lockport Group as used in Ontario, however, comprises only the lower two

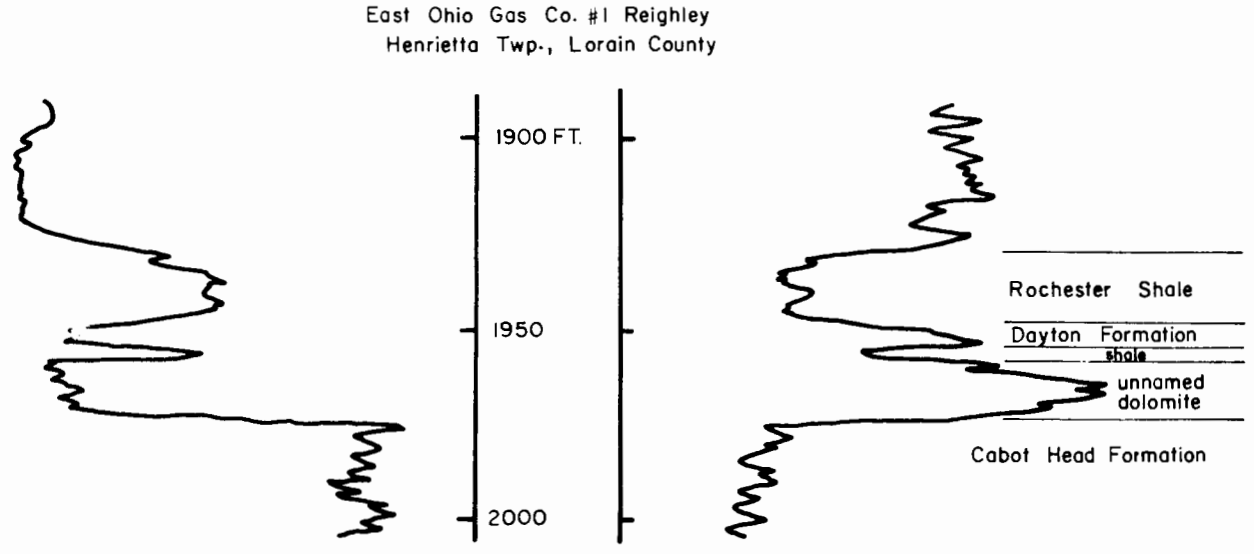

FIGURE 3.—Gamma ray-neutron log showing shale below the Dayton Formation.

formations of the Lockport as used here). This correlation was first suggested to the writer by a visiting petroleum geologist. Representative samples of the Lockport section of the report area were subsequently examined by Bruce V. Sanford, Geological Survey of Canada, who confirmed the validity of the correlation (personal communication, March 1968). A detailed study by Sanford of subsurface Silurian stratigraphy of southwestern Ontario is to be published by the Geological Survey of Canada.

Gasport Formation.—The Lockport Group in the South Birmingham Pool area can be divided into three units; where the Lockport has a biohermal facies (figs. 4 and 5), division into four units is possible. At the base of the Lockport is a somewhat porous granular-looking finely to coarsely crystalline predominantly bluish-gray dolomite with minor amounts of white and light- to medium-gray dolomite. Its thickness ranges from 25 to 33 feet and averages about 28 feet. The unit is distinctive, both in the cuttings and on the gamma ray-neutron log (figs. 2 and 4), and is correlated with the Gasport Formation of southwestern Ontario. The Gasport was named by Kindle (Kindle and Taylor, 1913, p. 7) for exposures of 9 to 20 feet of coarse-grained crinoidal white to gray limestone near Gasport, Niagara County, New York. In its type area the Gasport is described as a "massive, thick- to thin-bedded, blue-grey to grey to white, coarse- to fine-grained, semi-crystalline, knobby weathering, crinoidal, dolomitic limestone" which has a maximum exposed thickness of about 21 feet (Bolton, 1957, p. 46).

Goat Island Formation.—Overlying the Gasport in the report area is a finely crystalline very light-brown to yellowish-brown silty dolomite containing fossiliferous white and gray chert. The thickness of this unit ranges from 45 to 55 feet. This dolomite is correlated with the Goat Island Formation of the Niagara escarpment in New York and Ontario. Goat Island (member of the Lockport Formation) was the name used by Howell and Sanford (1947, p. 34) for dolomite overlying the Gasport on Goat Island near Niagara Falls. These authors proposed the term to replace the name Suspension Bridge Dolomite (Cumings, 1939, p. 597) because the latter was preoccupied. The Goat Island is described in its type area as a "massive, irregularly bedded, buff to white, dark to light grey, dense to fine-grained dolomite" which is abundantly cherty and as much as 60 feet thick (Bolton, 1957, p. 49). Bruce V. Sanford (personal communication) comments on the Goat Island of the South Birmingham Pool area that it is "not truly typical of the Goat Island at the type section, but it resembles that formation as it approaches the Algonquin arch in Ontario."

The contact with the overlying Guelph Formation is described under the Guelph.

Guelph Formation.—Overlying the Goat Island in the area is either one of two distinctly different dolo-

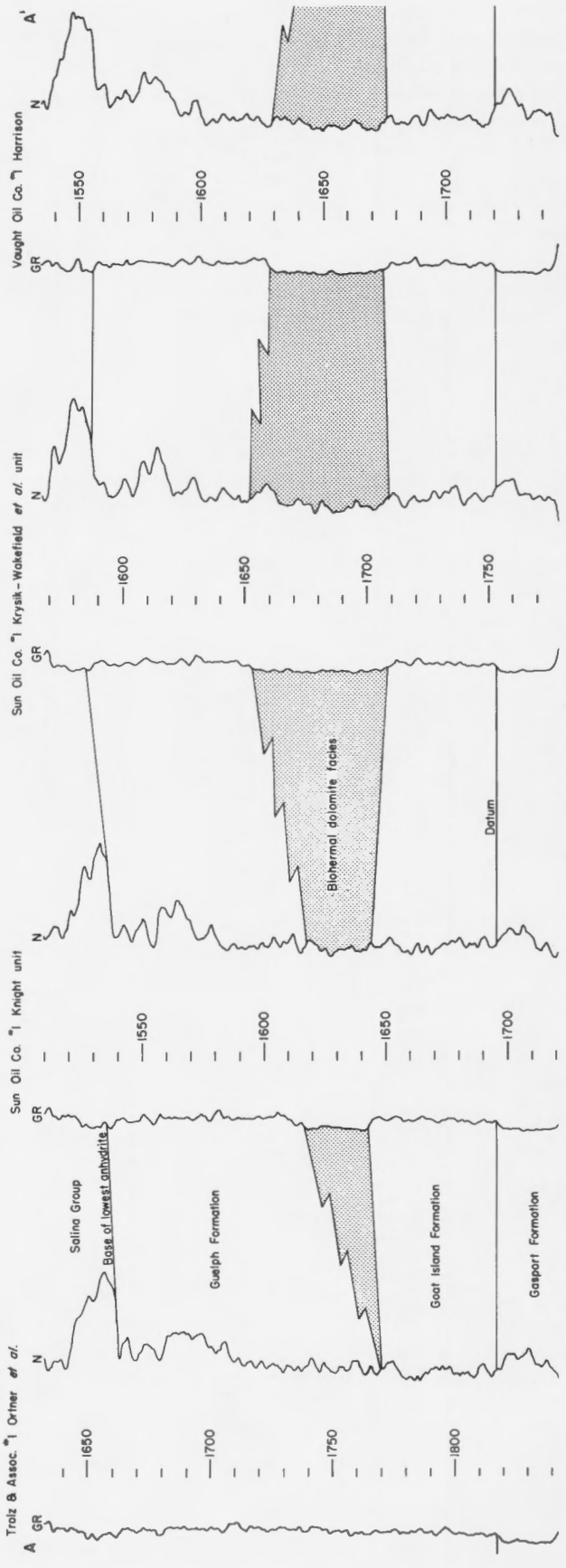

FIGURE 4.—Gamma ray-neutron log cross section of the Lockport Group showing biohermal facies. Vertical scale shown on logs; no horizontal scale. Location of cross section shown in figure 5.

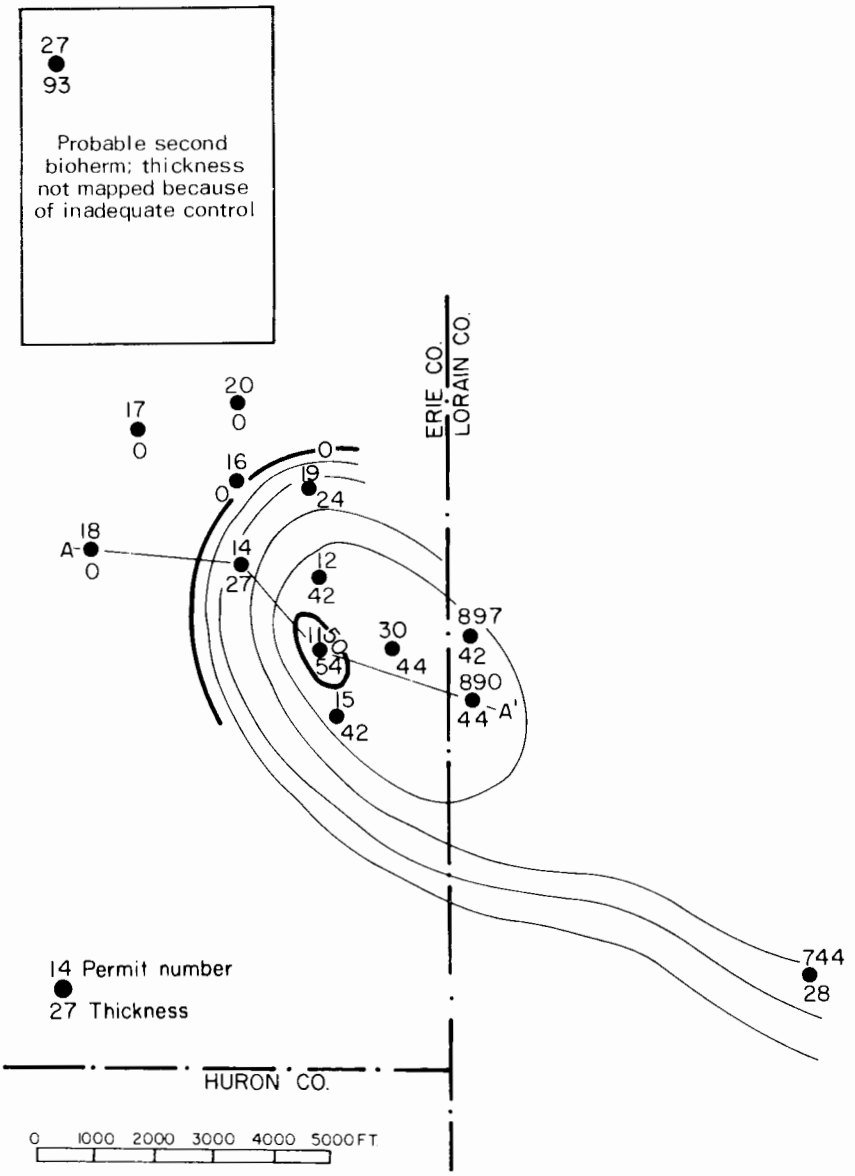

FIGURE 5.—Thickness of the biohermal facies of the Guelph Formation. See figure 4 for cross section.

mites. Locally, as within the area in which the thickness has been mapped (fig. 5), the Goat Island is overlain by a finely to medium-crystalline light-gray to white vuggy dolomite which ranges in thickness from 0 to more than 50 feet, and this dolomite is in turn overlain by a very finely to finely crystalline light-yellowish- to medium-brown dolomite. This same sequence occurs in well 27, where the vuggy dolomite is 93 feet thick. In other wells in the report area, the brown dolomite directly overlies the Goat Island.

The lower and upper contacts of the vuggy dolomite are distinct in the samples and on the gamma ray-neutron log (fig. 2). The lower contact of the brown dolomite where this unit directly overlies the Goat Island is indistinct on the gamma ray-neutron log and is drawn in the samples at the top of the highest chert in this part of the section. The upper contact of the brown dolomite with the Salina is distinct (fig. 2) and is drawn at the base of the lowest bedded anhydrite in the section (Ulteig, 1964).

The thickness of the sequence between the Goat Island and the Salina ranges from 100 to 160 feet and increases with an increase in the thickness of the vuggy dolomite. In well 18, where the vuggy dolomite is not present, the thickness of the post-Goat Island Lockport is 110 feet; in well 27, where the vuggy dolomite is 93 feet thick, the thickness of the Lockport above the Goat Island is 160 feet.

The lithology and thickness of the vuggy unit and its evident facies relationship with the brown dolomite

(fig. 4) suggest that it has a biohermal origin. Two separate bioherms may exist within the area shown in figure 5. A sufficient number of wells have been drilled to show the approximate areal extent of the southern one of these, but control is inadequate to outline the northern one.

The brown and vuggy dolomite units are correlated with the Guelph Formation of southwestern Ontario. The name Guelph Formation was given by Logan (1863, p. 336-338) to exposures of fossiliferous and porous light-colored dolomite near Guelph, Wellington County, Ontario, where the formation overlies the Goat Island and underlies Salina rocks.

The biohermal facies of the Guelph is economically important because of its potential to produce gas or oil. Where the biohermal dolomite is structurally high, as in well 11, the samples are heavily oil-stained. In this well, 224,000 and 455,000 cubic feet of gas per day were reported at depths of 1,666 and 1,677 feet, respectively (fig. 4). Gas shows have also been reported from structurally high biohermal facies of the Guelph in the Collins Pool area in Townsend Township, Huron County (fig. 1), where the Lockport section is similar to that in the report area. The reservoir rock from which oil is produced in the Collins Pool is Cambrian dolomite.

Additional gas shows are reported in the South Birmingham Pool area from a porous zone in the uppermost (brown) Guelph dolomite. This porous zone is found immediately below the lowest anhydrite in the section and is referred to by drillers as the Newburg zone.

Salina Group

The name Salina was applied by Dana in 1863 to salt beds in Cayuga and Onondaga Counties, New York, but the stratigraphic limits of the formation or group have been redefined a number of times since then. The modern definition, for the Michigan and Appalachian Basins, is that of Landes (1945), who subdivided the Salina into seven units designated A to G in ascending order. The lithology and thickness of the Salina Group in an area including that of this report have been adequately described by Ulteig (1964) and the Salina is therefore treated summarily here.

The Salina in the report area consists of dense to microcrystalline gray and brown dolomite which is argillaceous to very argillaceous in part and is interbedded with anhydrite and minor amounts of gray and greenish-gray shale. Minor amounts of dense brown limestone occur in the A unit.

The thickness of the Salina in the South Birmingham Pool area ranges from 650 to 690 feet and averages about 670 feet. The presence of a thick biohermal Guelph facies does not affect either the thickness of the entire Salina Group or the thickness of the basal A unit.

As far as is known, the Salina forms a conformable sequence. Its contact with the overlying Raisin River Dolomite is placed at the top of the highest anhydrite bed in the section, and is distinct in the samples and on the gamma ray-neutron log.

Raisin River Dolomite

Raisin River Dolomite is the name given by Lane and others (1909, p. 554) to dolomite exposed along the Raisin River in Monroe County, Michigan. The unit is the uppermost formation in their Bass Islands series, which comprises the entire upper Silurian, and is underlain by the Put-in-Bay Dolomite and overlain by the Sylvania Sandstone (Devonian). The name of the series was derived from the Bass Islands of western Lake Erie. Ehlers and others (1951, p. 10) proposed the Bass Islands Group, to consist of the Put-in-Bay and Raisin River Dolomites in ascending order. However, accumulated evidence from surface and subsurface studies (Carman, 1927, p. 495; Landes, 1945; Alling and Briggs, 1961, p. 525; Ulteig, 1964, p. 42) has shown that the Bass Islands Group cannot be differentiated in most of the Ohio-Michigan region. It is probable that the Put-in-Bay Dolomite described from the islands of western Lake Erie is a local facies of the Raisin River Dolomite (Summerson, 1963, p. 54), and the writer therefore prefers to assign the Silurian dolomite above the Salina Group to the Raisin River Dolomite.

The Raisin River Dolomite in the study area is a microcrystalline light-gray, brownish-gray, and yellowish-brown dolomite which locally contains minor amounts of gray or black shale. Its thickness ranges from 50 to 75 feet and averages about 60 feet. Its upper contact with the Bois Blanc Formation (Devonian) is a regional unconformity. In the samples the change from microcrystalline (Raisin River) dolomite to medium-crystalline cherty (Bois Blanc) dolomite is distinct, but the contact is indistinct on the gamma ray-neutron log.

DEVONIAN SYSTEM

Bois Blanc Formation

The name Bois Blanc was given by Ehlers (1945, p. 80-109) to Devonian cherty limestone and dolomite exposed on Bois Blanc Island in the region of the Mackinac Straits of northern Michigan. In its type area the Bois Blanc is underlain by the Garden Island Formation (Devonian) or by dolomite of Silurian age and is overlain by the Detroit River Group. The Bois Blanc was first recognized in a published report in north-central Ohio by Dow (1962).

The Bois Blanc in the report area is a glauconitic and sandy medium-crystalline light-brownish-gray dolo-

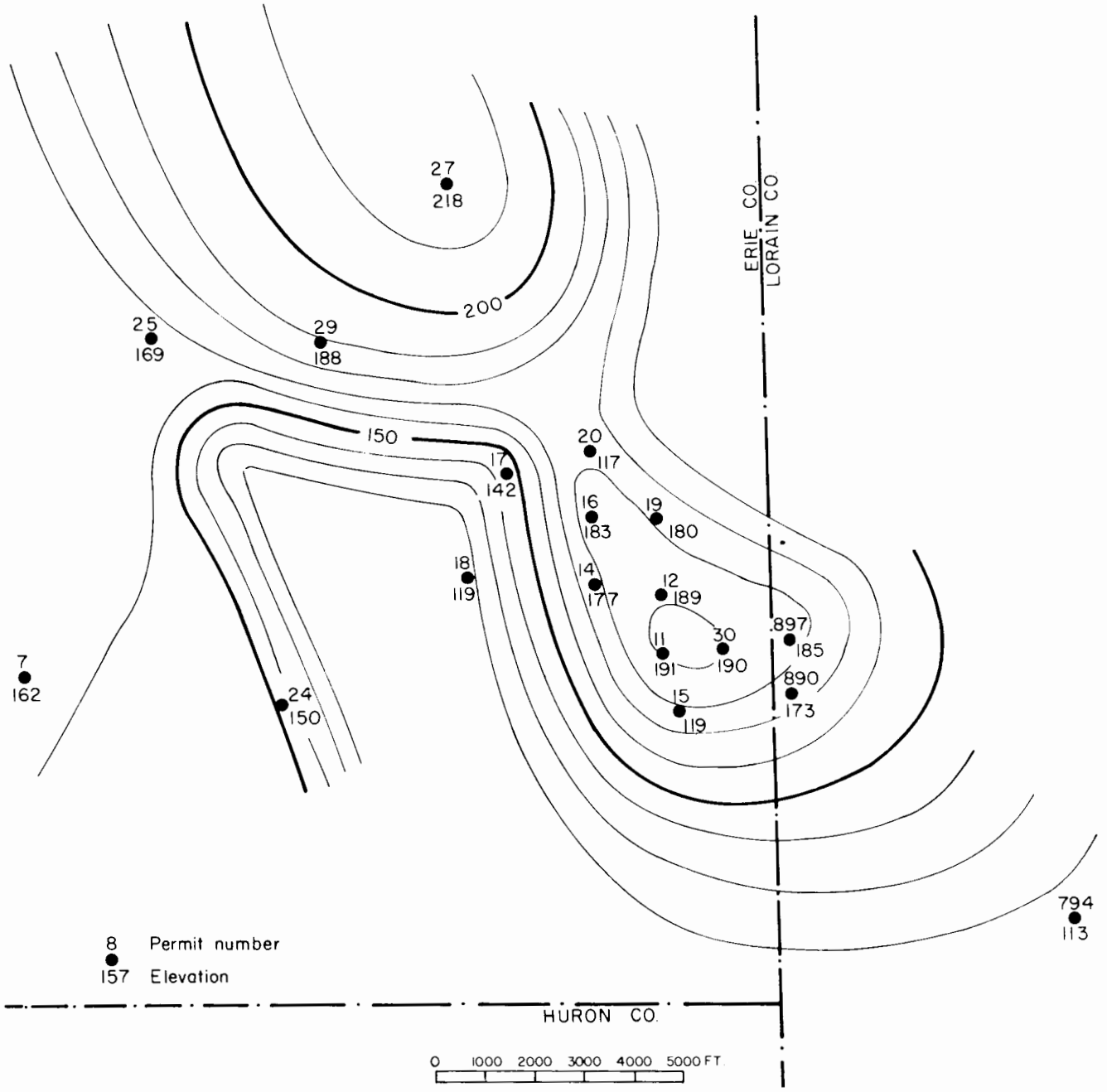

FIGURE 6.—Structure on top of the Delaware Limestone.

mite which has high intercrystalline porosity. The formation contains fossiliferous white and grayish-brown chert in amounts as much as 60 percent of a given sample interval. The sand grains in the Bois Blanc are fine in size and predominantly subrounded. Thickness of the formation ranges from 50 to 80 feet and averages about 70 feet.

The upper boundary of the Bois Blanc is its contact with the Columbus Limestone. This contact, which marks a regional unconformity, is distinct and is shown in the samples by the change from crystalline and cherty dolomite to fine- and medium-grained limestone. On the gamma ray-neutron log the contact is rather indistinct (fig. 2). South and west of the study area the Bois Blanc is truncated by the Columbus Limestone or by an equivalent part of the Detroit River Group.

Detroit River Group and Columbus Limestone

About 175 feet of limestone that overlies the Bois Blanc Formation and underlies the Delaware Limestone in the South Birmingham Pool is assigned by the

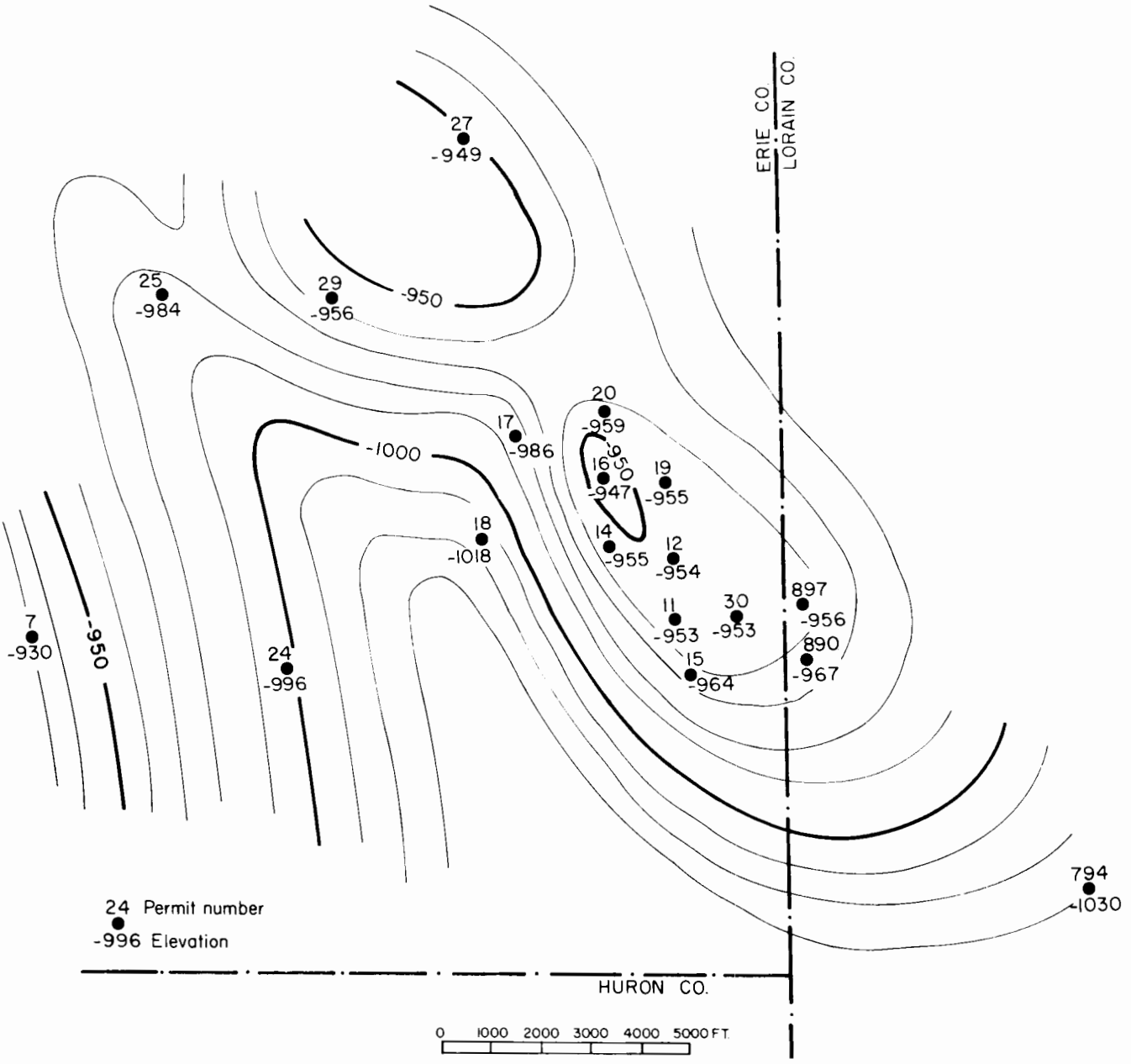

FIGURE 7.—Structure on top of the Rochester Shale.

writer to the Columbus Limestone. He believes, however, for reasons explained subsequently, that the lowest 60 to 70 feet of this unit represents a facies change of the Detroit River Group east of its outcrop in Sandusky County.

The name Columbus was used by Mather (1859, p. 25) for about 140 feet of limestone described from a well drilled in Columbus in Franklin County, Ohio. Included in Mather's Columbus was the formation now known as the Delaware Limestone. Newberry (1873, p. 143) defined the unit as overlying Silurian rocks and underlying the Delaware. The Columbus can be traced from its type area to the report area, where it is a fossiliferous fine- to coarse-grained light-brownish-gray to yellowish-gray limestone which contains fossiliferous gray and white chert. A zone 3 to 10 feet thick and consisting of fine-grained sandstone or sandy limestone lies 60 to 70 feet above the base of the Columbus in the study area. Some drillers have reported this as the Oriskany Sandstone for the reason that this sandstone is the first one found below the top of the Delaware Limestone (top of drillers' "Big Lime"). The identification is inaccurate. The stratigraphic position of the Oriskany is below that of the Bois Blanc and above that of the Raisin River. True Oriskany does not occur in the report area.

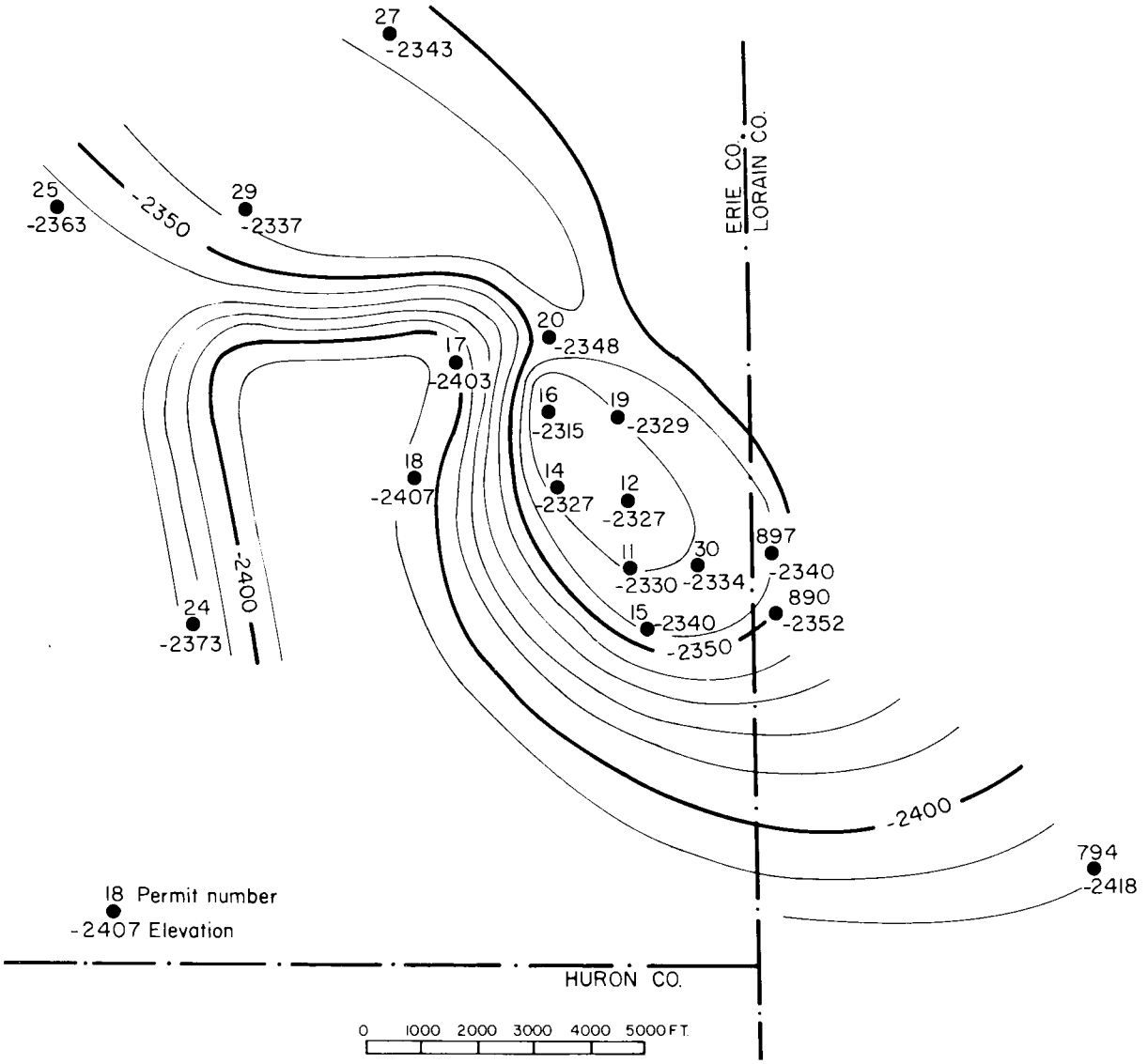

FIGURE 8.—Structure on top of the Trenton Limestone.

The thickness of the Columbus in the South Birmingham Pool area ranges from 170 to 190 feet and averages about 175 feet. The upper contact with the Delaware Limestone is distinct (fig. 2) and is identified in the samples by the change from fine- to coarse-grained yellowish-gray limestone to fine-grained light-brownish-gray limestone.

The name Detroit River series was used by Lane and others (1909, p. 555) for dolomite exposed along the Detroit River in Michigan and Ontario. The series in its type area overlies Raisin River dolomite and underlies Dundee [Delaware] Limestone. The presently accepted subdivision of the Detroit River Group is that of Ehlers and others (1951), who define it as the Sylvania Sandstone and the Amherstburg, Lucas, and Anderdon Dolomites in ascending order.

Middle Devonian carbonates cropping out to the west of the report area in the city of Bellevue in York Township, Sandusky County (fig. 1), belong in ascending order to the Detroit River Group (undifferentiated) and to the Columbus Limestone. In one quarry (N½ sec. 25), exposing about 70 feet of Detroit River and Columbus, the thickness of the Columbus has been reported to be 28 feet (Stauffer, 1909, p. 114), 38 feet (Struble, 1952, p. 75), and, by implication, a featheredge (Stumm and Foreman, 1945). These differing thickness figures suggest that there is interbedding or interfingering of Detroit River and Columbus lithologies which has resulted in assigning an arbitrary base to the Columbus. The stratigraphic top of the Columbus is absent in the quarry because of erosion.

Twenty-eight feet below the top of the eroded Columbus in the quarry is a one-inch bed of argillaceous and dolomitic sandstone. The limestone below this

sandstone is sandy and grades downward into dolomite. The sandstone may mark the base of the Columbus as interpreted by Stauffer (1909, p. 114).

In a report on the Middle Devonian limestones of northeastern Ohio, Dow (1962) discusses the relationship between the Detroit River and the Columbus. His conclusion is that east of Bellevue the Detroit River is truncated by the Columbus and is absent east of Erie County. In a core in Huron Township, Erie County, Dow (1962; unpublished core description) assigns 70 feet each to the Detroit River and to the Columbus.

The writer believes that, instead of being truncated by the Columbus, the Detroit River undergoes a facies change east of Bellevue and becomes lithologically indistinct from the Columbus.[1] The sandstone lying 60 to 70 feet above the base of the Columbus in the South Birmingham Pool area is believed to mark the approximate top of the otherwise lithologically indistinct Detroit River, which in this report is included in the Columbus Limestone.

Delaware Limestone

Delaware stone is the name given by Winchell (1874, p. 302) to exposures of argillaceous blue limestone in Delaware, Delaware County, Ohio. This formation can be traced from its type area to the report area, where it is a somewhat argillaceous fossiliferous fine-grained light-grayish-brown and medium-brown limestone which contains fossiliferous light- and medium-brown chert. Its thickness is nearly constant and ranges only from 30 to 33 feet. The contact with the overlying Olentangy Shale, believed to be a disconformity, is distinct (fig. 2) and is marked in the cuttings by the change from limestone to grayish-green and brownish-gray shale.

STRUCTURE

The regional structure of the report area has an easterly dip of about 11 feet per mile as measured on top of the Delaware Limestone. Superimposed on this regional structure, however, are two northwest-trending structures (figs. 6, 7, and 8), at least one of which shows moderate closure. This local structure dates from post-Middle Devonian time. It is interesting to note the similarity of the structure patterns on the three horizons shown: the top of the Delaware, the top of the Rochester, and the top of the Trenton Limestone (Ordovician). The structure of the Cambrian reservoir rock is known to duplicate essentially the structures of the higher horizons. This similarity indicates the possibility that other deep structures (on Trenton Limestone and sub-Trenton units) can be detected by mapping the structure of a shallow formation, such as the top of the Devonian and Silurian carbonate ("Big Lime") sequence.

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1. Oliver and others (1967, p. 1018-1019), in a paper published after this report was in press, consider the Detroit River "essentially a Michigan basin facies of the Columbus-Onondaga. To the east [of north-central Ohio] the Detroit River Group and the Columbus Limestone pass into the Onondaga Limestone."

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APPENDIX - SAMPLE DESCRIPTIONS

Erie County
Florence Township
Lot 98

Sun Oil Co. #1 Krysik-Wakefield *et al.* unit
Permit No. 11
Sample No. 1928
Elevation (KB) 828 feet

Depth (ft)	
	Samples above 600 feet not examined
590 - 600	Shale, medium-gray, calcareous
600 - 610	No samples
610 - 620	Shale as above
620 - 630	Shale as above
630 - 640	Shale as above. Limestone, medium- to dark-brownish-gray, fine-grained, pyritic and very argillaceous. DELAWARE LIMESTONE AT 637 FEET
640 - 650	Limestone, medium-brown, fine- to medium-grained, fossiliferous. Shale as above
650 - 660	Limestone, medium-brown and light-brownish- to yellowish-gray, fine-grained. Chert, medium-brown; trace
660 - 670	Limestone as above. Limestone, light-brownish- to yellowish-gray, fine- to coarse-grained, fossiliferous. Chert as above, trace. Pyrite, trace. COLUMBUS LIMESTONE AT 667 FEET
670 - 770	Limestone as above, fine- to coarse-grained; in part finely to coarsely crystalline. Shale, brown; in 670-680 foot sample; trace. Chert, white and light-gray; 20% in 750-770 foot sample; trace in 690-720, 740-750 foot samples
770 - 780	Limestone, light-brownish-yellow, fine- to medium-grained; sandy in part; granular-looking. Sand, fine-grained, subangular to rounded, loose; heavy trace. Chert, white; trace
780 - 790	Limestone, medium- to dark-brown, fine- to medium-grained. Limestone, very light-yellowish-gray to medium-brown, finely to medium-crystalline, dense. Sand as above, trace
790 - 840	Limestone and sand as above. Limestone, granular-looking; as in 770-780 foot sample; minor. Chert, white, fossiliferous; heavy trace in 810-830 foot sample
840 - 860	Dolomite, medium-brown to grayish-brown, finely to medium-crystalline; some porosity in small vugs; very sandy; sand fine and angular. Chert, white, with dolomite crystals embedded; 10%. Chert as above, 20-30% in 850-860 foot sample. BOIS BLANC FORMATION AT 841 FEET
860 - 870	Dolomite, very light-brownish-gray, finely to medium-crystalline. Sand, fine; trace
870 - 900	Chert, white and brown; 60-70%. Dolomite, medium-brown, slightly grayish, finely to medium-crystalline. Sand as above
900 - 910	Dolomite as above, slightly glauconitic. Chert as above, 30-40%. Sand as above, trace. SILURIAN (RAISIN RIVER DOLOMITE) AT 913? FEET
910 - 920	Dolomite, light-yellowish-brown, microcrystalline to very finely crystalline. Shale, black; trace
920 - 930	Dolomite as above. Dolomite and chert as in 900-910 foot sample (cavings). Shale, black and light-gray; heavy trace
930 - 940	No samples
940 - 960	Dolomite as in 910-920 foot sample
960 - 970	Dolomite, light- and medium-brown, dense to microcrystalline, clayey, laminated. Shale, dark-gray; trace
970 - 990	Anhydrite. Dolomite as above, minor. SALINA GROUP (UNDIFFERENTIATED) AT 975 FEET
990 - 1000	Dolomite as above. Anhydrite, 10-20%
1000 - 1010	Dolomite as above. Dolomite, light-greenish-gray, very argillaceous, pyritic. Anhydrite, 10-20%
1010 - 1020	Dolomite, very argillaceous; as above; grading into shale
1020 - 1030	Dolomite and shale as above. Dolomite, light- to medium-brown, microcrystalline, anhydritic. Anhydrite, 5-10%
1030 - 1040	Dolomite, medium- and dark-grayish-brown, microcrystalline, argillaceous, anhydritic. Anhydrite, 20-30%
1040 - 1050	Dolomite as above, light- and medium-grayish-brown. Dolomite, medium-gray, very argillaceous
1050 - 1060	Dolomite, medium-gray and light-greenish-gray, microcrystalline, very argillaceous; grading into shale. Dolomite, light- and medium-brown, dense, clayey. Anhydrite, 10-20%
	Samples from 1060-1550 described from strip-logged samples
1060 - 1070	Anhydrite, 50-60%. Dolomite, light- and medium-brown, microcrystalline, anhydritic
1070 - 1080	Dolomite as above. Dolomite, light-brownish-gray. Anhydrite, 10-20%
1080 - 1090	Dolomite as above. Anhydrite, 30-40%. Shale, dark-gray; heavy trace
1090 - 1100	Dolomite and shale as above. Anhydrite, 10%
1100 - 1110	Dolomite, light- to medium-brown, dense to microcrystalline, anhydritic. Dolomite, medium-gray, very argillaceous. Anhydrite, 10%. Shale, dark-gray; trace
1110 - 1120	Dolomite, medium-brown and dark-gray, dense to microcrystalline. Anhydrite, trace
1120 - 1130	Dolomite, light- and medium-brown, microcrystalline, anhydritic. Anhydrite, 40-50%
1130 - 1150	Dolomite, light- to medium-greenish-gray, microcrystalline, very argillaceous; grading into shale. Anhydrite, 10%
1150 - 1200	Dolomite, light- and medium-brown, dense and microcrystalline; anhydritic in part. Dolomite, medium-gray, argillaceous. Anhydrite, 10-20%
1200 - 1230	Dolomite, light- and medium-brown, dense to microcrystalline; anhydritic in part. Anhydrite, 20-30%

1230 - 1330	Dolomite, light- and medium-brown, dense to microcrystalline. Dolomite, light- to medium-greenish-gray, very argillaceous; grading into shale and increasing in proportion to brown dolomite with increased depth. Anhydrite, trace to 20%
1330 - 1350	Dolomite, light- and medium-brown, dense and clayey to microcrystalline. Dolomite, light- to medium-greenish-gray, argillaceous
1350 - 1440	Dolomite, very light-brownish-gray to medium-brown, dense to microcrystalline; anhydritic in part. Anhydrite, trace to 20%. Dolomite as above; greenish-gray, very argillaceous, minor
1440 - 1480	Dolomite, light- and medium-grayish-brown and brown, microcrystalline to very finely crystalline
1480 - 1510	Dolomite, dark-gray, microcrystalline, argillaceous and very argillaceous. Dolomite, light-brownish-gray and medium-brown, microcrystalline to very finely crystalline
1510 - 1540	Anhydrite, 40-60%. Dolomite, light-grayish-brown, microcrystalline. Shale, dark-gray, dolomitic
1540 - 1550	Dolomite, medium-brown and grayish-brown, microcrystalline. Anhydrite, 10%
	End of description of strip-logged samples
1550 - 1560	Shale, very dark-gray, dolomitic. Dolomite, very dark-brown, microcrystalline, anhydritic. Anhydrite, 10%
1560 - 1570	Dolomite, light- to medium-brown, microcrystalline. Dolomite as above, dark-brown. Anhydrite, 10%
1570 - 1590	Dolomite as above. Anhydrite, 20%. LOCKPORT GROUP (GUELPH DOLOMITE) AT 1587 FEET
1590 - 1600	Dolomite, light-brown and grayish-brown to dark-brown, microcrystalline to very finely crystalline. Anhydrite, 30%. Limestone, medium- to dark-brown, dense, dolomitic; trace. Shale, dark-gray; trace
1600 - 1610	Dolomite, medium-brown, finely and medium-crystalline (mostly fine), with scattered vuggy and pinpoint porosity; some oil stain
1610 - 1630	Dolomite as above. Dolomite, light- and medium-brown, microcrystalline to very finely crystalline
1630 - 1660	Dolomite as above, in part very light-brownish- to yellowish-gray and light-gray. GUELPH BIOHERMAL FACIES AT 1653 FEET
1660 - 1700	Dolomite, light-gray, finely crystalline, vuggy; heavy oil stain
1700 - 1710	Dolomite, light- to very light-gray and yellowish-gray, finely crystalline, vuggy. GOAT ISLAND DOLOMITE AT 1707 FEET
1710 - 1720	Dolomite as above. Dolomite, very light-brown. Chert, white and light-brownish-gray; trace
1720 - 1750	Dolomite, light- to medium-brown and yellowish-brown, very finely to medium-crystalline (mostly fine). Chert, white and light-brownish-gray, fossiliferous; heavy trace
1750 - 1760	Dolomite as above, minor. Dolomite, medium-gray, finely to coarsely crystalline, fossiliferous; many small vugs. GASPORT DOLOMITE AT 1754 FEET
1760 - 1770	No samples
1770 - 1780	Dolomite as above. Dolomite, medium-gray, argillaceous, pyritic. Shale, medium-gray; trace
1780 - 1790	Dolomite, very argillaceous; grading into shale, medium-gray, slightly brownish, crinoidal. ROCHESTER SHALE AT 1781 FEET
1790 - 1800	Dolomite and shale as above. Dolomite, very light-brown to yellowish-brown, dense, very finely crystalline, slightly glauconitic. DAYTON FORMATION AT 1799 FEET
1800 - 1810	Dolomite, very light-gray and yellowish- and brownish-gray; vuggy mottled yellow in part; finely to medium-crystalline, very slightly glauconitic. Dolomite, medium-gray, finely to medium-crystalline; some pinpoint porosity
1810 - 1820	Dolomite as above, mostly medium-gray
1820 - 1830	Dolomite as above. Shale, light-greenish-gray; trace. CABOT HEAD FORMATION AT 1828 FEET
1830 - 1840	Shale as above, slightly fossiliferous. Dolomite, medium-brown, finely crystalline; trace
1840 - 1850	Shale as above. Dolomite, light- to medium-grayish-brown, coarsely bioclastic; trace
1850 - 1860	Shale as above
1860 - 1870	Shale as above. Dolomite, coarsely bioclastic, hematitic. Dolomite, light-brownish-gray to gray; mottled yellow; finely crystalline, fossiliferous
1870 - 1880	Shale as above. Dolomite as above, trace
1880 - 1890	Shale and dolomite as above. Shale, red; trace
1890 - 1900	Shale as above. Dolomite, light-grayish-brown, coarsely bioclastic, very hematitic. Sandstone, dense, very fine-grained, slightly dolomitic; trace
1900 - 1920	Shale and dolomite as above. Sandstone, 10-20%; grading into dolomite, light-grayish-brown, fine- to medium-crystalline
1920 - 1930	Dolomite, hematitic, medium-crystalline (bioclastic). Dolomite, light-grayish-brown, medium-crystalline, sandy; grading into dolomitic sandstone. Shale, light- to medium-greenish-gray; 10%
1930 - 1940	Dolomite as above. Shale as above, 10%. Sandstone as above, trace. Limestone, white, coarsely crystalline; trace. BRASSFIELD FORMATION AT 1939? FEET
1940 - 1960	Limestone, light- and medium-gray and grayish-brown, coarse-grained and crystalline, dolomitic, glauconitic, fossiliferous. Limestone, light-greenish-gray, argillaceous, silty, dense; minor; grading into shale. Chert, light-brown; trace. Sandstone as above, trace
1960 - 1970	Shale, red, light-green. Limestone; argillaceous as above; minor. ORDOVICIAN AT 1968 FEET
	End of logged interval.

Erie County
Florence Township
Lot 77

Glynn Trolz & Assoc., Inc. #1 Ortner *et al.*
Permit No. 18
Sample No. 1967
Elevation (KB) 824 feet

Depth (ft)	
	Samples above 710 feet not examined
700 - 710	Shale, medium-brownish-gray. Limestone,

	light- to medium-grayish-brown to brown, fine-grained. DELAWARE LIMESTONE AT 706 FEET
710 - 720	Limestone as above
720 - 740	Limestone as above. Shale, dark-brown, micaceous; trace. Limestone, light-yellowish-gray, fine-grained; trace. COLUMBUS LIMESTONE AT 737 FEET
740 - 750	Limestone, very light-yellowish- to brownish-gray, fine- to medium-grained, coarsely bioclastic. Chert, white, fossiliferous; trace
750 - 840	Limestone as above. Limestone, light-yellowish-brown. Chert, white; trace in 780-790, 820-840 foot samples
840 - 860	Limestone as above. Chert, white; heavy trace. Sand, fine-grained, rounded and frosted; showing secondary growth; heavy trace
860 - 900	Limestone and sand as above. Limestone, light-yellowish-brown to brownish- and grayish-yellow, dense, very finely crystalline to microcrystalline. Chert, white; trace
900 - 910	Limestone as above. Chert as above; trace
910 - 920	No samples. BOIS BLANC FORMATION AT 911? FEET
920 - 930	Dolomite, light-brownish-gray, finely to medium-crystalline; excellent intercrystalline porosity. Limestone as above; trace. Chert, white; trace
930 - 960	Dolomite as above, slightly glauconitic. Chert, white; heavy trace
960 - 970	Dolomite as above. Chert, white; 10%
970 - 980	Dolomite as above. Dolomite, very light- to medium-grayish-brown and brown, microcrystalline to very finely crystalline. Chert, white and grayish-brown; heavy trace. Sand, fine-grained and rounded; trace
980 - 1000	Dolomite, microcrystalline to very finely crystalline, and chert as above. RAISIN RIVER DOLOMITE AT 982 FEET
1000 - 1600	Samples not examined
1600 - 1620	Dolomite, very light-brownish-gray and light- and medium-grayish-brown, microcrystalline. Shale, black and very dark-brown; 10%. Anhydrite, trace
1620 - 1650	Dolomite, shale, and anhydrite as above. Limestone, medium- to dark-brown, dolomitic, dense; heavy trace
1650 - 1660	Dolomite and shale as above. Limestone as above, 30-40%
1660 - 1690	Dolomite, light- and medium-brown and yellowish- to grayish-brown, microcrystalline to very finely crystalline. Shale, black and dark-grayish-green, smooth; trace. Chert, white and light-grayish-brown, trace in 1670-1690 foot sample. GUELPH FORMATION AT 1661 FEET
1690 - 1700	Dolomite, light-yellowish-brown to medium-brown, very finely to finely crystalline; more lustrous than dolomite in 1660-1690 foot sample
1700 - 1770	Dolomite, light-grayish-brown and light- to medium-brown, microcrystalline to finely crystalline. Shale, black; trace. Chert, white; trace in 1710-1730 foot sample
1770 - 1780	Dolomite, very light-yellowish- to brownish-gray, dense to finely crystalline, silty. Chert, white; trace. (GOAT ISLAND FORMATION?)
1780 - 1830	Dolomite as above. Dolomite, medium-brown; minor. Chert, white; trace. GASPORT FORMATION AT 1819 FEET
1830 - 1850	Dolomite, light-gray, finely to coarsely crystalline. Glauconite, trace. Dolomite, medium-brown as above; minor
1850	Dolomite, light-gray as above, and medium-gray, light-yellowish-brown and medium-brown, finely to medium crystalline. Dolomite, white and light-gray; heavy trace
	End of logged interval.

Lorain County
Henrietta Township
Lot 8

East Ohio Gas Co. #1
Born
Permit No. 794
Sample No. 894
Elevation (DF) 850 feet

Depth (ft)	
	Samples above 739 feet not examined
735 - 739	Shale, medium-gray, calcareous. DELAWARE LIMESTONE AT 737 FEET
739 - 742	Limestone, light-grayish-brown, fine-grained. Shale as above, heavy trace
742 - 760	Limestone as above, in part coarsely crystalline
760 - 763	Limestone, medium-brown, dense, fine- to medium-grained. Chert, medium-brown; heavy trace. Limestone as above, trace. Shale, medium- to dark-brown, micaceous; trace
763 - 770	No samples. COLUMBUS LIMESTONE AT 768 FEET
774 - 782	Limestone and chert as above. Limestone, light-yellowish- to brownish-gray, fine- to medium-grained, fossiliferous
782 - 793	Limestone as above, yellowish- to brownish-gray, fossiliferous; light- to medium-gray in part; coarsely bioclastic in part. Chert, white and light-gray, fossiliferous; heavy trace
793 - 886	Limestone, light-yellowish-brown to yellowish-gray, fine- to coarse-grained, fossiliferous. Chert, white and gray, fossiliferous; trace. Chert as above, 10-20% in 859-886 foot sample
886 - 922	Limestone as above. Limestone, light-yellowish-brown and white (coralline), microcrystalline to very finely crystalline. Limestone, medium- to dark-brown, medium- to coarse-grained; trace
922 - 927	Limestone as above. Limestone, medium-brown, fine- to medium-grained
927 - 941	Limestone as above; most of limestone very finely crystalline as in 886-922 foot sample. Chert, white; trace
941 - 946	No samples. BOIS BLANC FORMATION AT 946 FEET
946 - 955	Dolomite, light-gray to brownish-gray, finely to medium-crystalline; good intercrystalline porosity. Chert, white, with dolomite crystals; 40-50%
955 - 959	Dolomite as above, mostly light- to medium-brown, slightly glauconitic. Chert as above, 10-20%
959 - 971	Dolomite, light- to medium-brown, fine-grained and crystalline, calcareous. Chert as above, 5-10%
971 - 978	No samples
978 - 982	Dolomite as above, predominantly light-gray

	to brownish-gray. Chert, white; 10-20%
982 - 987	Dolomite as above. Chert as above, 50%
987 - 991	Chert as above, 50-60%. Dolomite as above
991 - 998	Chert, 50-60%. Dolomite, light- and medium-brownish-gray, fine-grained and crystalline, slightly glauconitic
998 - 1006	Chert, white and brown, sandy; 50-60%. Dolomite as above, sandy; sand fine-grained, subangular to subrounded
1006 - 1014	Dolomite and chert as above. Dolomite, light-gray, microcrystalline. SILURIAN (RAISIN RIVER DOLOMITE) AT 1012 FEET
1014 - 1021	Dolomite, light-gray and brown, microcrystalline; some vuggy porosity. Dolomite and chert as in 998-1006 foot sample; trace
1021 - 1024	Dolomite, light-brown to yellowish-brown, dense, microcrystalline
1024 - 1036	Dolomite as above. Dolomite, light gray; minor vuggy porosity
1036 - 1060	Dolomite, light-brownish-gray, microcrystalline; some pinpoint porosity
1060 - 1070	Dolomite as above. Dolomite, light-gray
1070 - 1075	Dolomite, very light-brown and brownish-gray, microcrystalline
1075 - 1079	Dolomite, light- and yellowish-brown and light-gray, microcrystalline. Shale, dark-gray; trace
1079 - 1084	Dolomite, light- and medium-grayish-brown, microcrystalline
1084 - 1091	Dolomite as above, light- and medium-grayish-brown and brown, microcrystalline to very finely crystalline. SALINA GROUP (UNDIFFERENTIATED) AT 1090 FEET
1091 - 1097	Dolomite, light- and medium-brown, microcrystalline, laminated. Anhydrite, 10-20%. Chert, light-gray; trace
1097 - 1117	Dolomite as above, anhydritic. Anhydrite, 30-40%. Chert, trace
1117 - 1124	Dolomite as above, dark-brown in part. Anhydrite, 10%. Chert, light-gray; trace
1124 - 1132	Dolomite as above, somewhat clayey. Anhydrite, 40-50%
1132 - 1143	Dolomite, medium-gray, microcrystalline, very argillaceous. Anhydrite, 10%
1143 - 1154	Anhydrite and dolomite as above. Dolomite, medium-brown, microcrystalline
1154 - 1160	Dolomite, light- to medium-brown, microcrystalline. Dolomite as above; medium-gray, very argillaceous. Shale, medium-gray; trace
1160 - 1171	Dolomite as above, medium-gray, very argillaceous. Dolomite as above, brown; minor. Anhydrite, heavy trace. Shale, dark-gray; heavy trace
1171 - 1181	Dolomite as above. Anhydrite, 10-20%
1181 - 1192	Dolomite, dark-brown and medium-gray, microcrystalline, anhydritic; very argillaceous in part. Anhydrite, 30%. Shale, dark-gray; heavy trace
1192 - 1200	Dolomite, light- to medium-brown, lithographic to microcrystalline; clayey in part
1200 - 1208	Dolomite, light- to dark-brown and grayish-brown, lithographic to microcrystalline; anhydritic in part. Anhydrite, 10-20%
1208 - 1214	Dolomite, medium-gray, microcrystalline, very argillaceous. Dolomite, medium-brown, microcrystalline to very finely crystalline
1214 - 1236	Dolomite as above. Anhydrite, 20-30%
1236 - 1273	Dolomite, dark-brownish-gray and light- and medium-brown, dense to microcrystalline. Anhydrite, trace. Shale, dark-gray; trace
1273 - 1285	Dolomite, medium-gray to brownish-gray, microcrystalline; grades into shale. Dolomite, light- to medium-brown, microcrystalline to very finely crystalline. Anhydrite, 10%
1285 - 1290	Dolomite, very light-yellowish-brown to dark-brown, microcrystalline. Dolomite as above, argillaceous; trace. Anhydrite, trace
1290 - 1295	Dolomite, very light-yellowish-brown, microcrystalline to very finely crystalline
1295 - 1301	Dolomite as above, light-brown. Shale, dark-gray, dolomitic; trace
1301 - 1308	No samples
1308 - 1328	Dolomite as above, anhydritic in part. Anhydrite, trace
1328 - 1332	Dolomite as above
1332 - 1337	No samples
1337 - 1354	Dolomite, medium- to dark-gray, microcrystalline, anhydritic and very argillaceous. Dolomite, light- and medium-brown, microcrystalline, anhydritic. Anhydrite, trace
1354 - 1361	Dolomite, light-greenish-gray, microcrystalline, anhydritic, very argillaceous. Anhydrite, trace
1361 - 1368	Dolomite and anhydrite as above. Shale, light-greenish-gray, dolomitic
1368 - 1378	Dolomite, anhydrite, and shale as above. Dolomite, light- and medium-brown, dense to microcrystalline; clayey in part
1378 - 1407	Dolomite and shale as above, light-greenish-gray. Dolomite, light-brownish-gray and light- to medium-brown, microcrystalline
1407 - 1412	Dolomite, light-grayish- to medium-brown, dense to microcrystalline, laminated. Dolomite, medium- to dark-gray, argillaceous. Shale, dark-gray; trace
1412 - 1443	Shale, dolomitic; grading into dolomite, light-greenish-gray, very argillaceous. Dolomite, medium-grayish-brown, microcrystalline. Anhydrite, trace
1443 - 1450	Dolomite, mottled greenish-gray and grayish-brown, microcrystalline, argillaceous, pyritic. Dolomite, light-brown, dense
1450 - 1457	Anhydrite, brown; 60-70%. Dolomite, light-yellowish-brown, dense
1457 - 1462	Dolomite as above. Anhydrite, heavy trace
1462 - 1493	Dolomite, light-brownish-gray and medium-brown, dense to microcrystalline. Anhydrite, trace. Shale, medium-gray; trace
1493 - 1504	Shale, light-grayish-green, pyritic, very dolomitic. Dolomite, light- and medium-brown, dense. Anhydrite, 10%
1504 - 1515	Shale and dolomite as above. Anhydrite, 20-30%
1515 - 1529	Dolomite, very light-brownish-yellow, dense. Anhydrite, 30-40%
1529 - 1531	No samples
1531 - 1536	Dolomite, very light-brownish-yellow to medium-grayish-brown, microcrystalline
1536 - 1547	Dolomite, light-yellowish-brown to medium-brown, dense to microcrystalline
1547 - 1570	Dolomite, light- to medium-brown and grayish-brown, very finely to finely crystalline
1570 - 1576	Dolomite, light- and medium-brownish-gray, dense to microcrystalline
1576 - 1582	Anhydrite. Shale, very dark-gray, dolomitic; trace
1582 - 1595	Dolomite, light-brownish-gray and medium-

Columns on this page reversed

	gray, finely to medium-crystalline, sandy; sand grains fine and angular
1915 - 1924	Dolomite, sandy; as above
1924 - 1932	Dolomite, sandy; as above; hematitic in part. Hematite oölites, trace. Shale, light- to medium-greenish-gray; heavy trace. CABOT HEAD FORMATION AT 1927 FEET
1932 - 1950	Shale as above. Sandstone, light-gray, very fine-grained, slightly dolomitic; trace
1950 - 1956	Shale as above. Shale, medium-gray
1956 - 1968	Shale as above. Dolomite, light-brownish-gray, medium- to coarse-grained and crystalline, fossiliferous, hematitic
1968 - 1979	Shale as above. Dolomite, yellow, light-gray, and brownish-gray, mottled, coarse-grained, finely to medium-crystalline, fossiliferous. Dolomite, hematitic; as above; trace in 1974-1979 foot sample
1979 - 1988	Dolomite, light- and medium-brown and gray, fine- to coarse-grained and crystalline, fossiliferous, hematitic. Shale as above
1988 - 1996	Dolomite and shale as above. Sandstone, light-gray, dolomitic, fine-grained; trace
1996 - 2004	Dolomite, shale, and sandstone as above. Sandstone, 10%
2004 - 2013	Sandstone, very light-brownish-gray, fine-grained. Shale, light- to medium-greenish-gray
2013 - 2021	Dolomite, light- and medium-brown and gray, fine to coarse-grained and crystalline, fossiliferous; very hematitic in part. Shale as above, minor. Sandstone as above, trace
2021 - 2028	Limestone, light-gray and brownish-gray, fine- to coarse-grained and crystalline, fossiliferous and glauconitic. Shale as above. Sandstone as above, heavy trace
2028 - 2043	Limestone and shale as above (limestone not glauconitic; in part argillaceous). BRASSFIELD FORMATION AT 2040 FEET
2043 - 2057	Limestone and shale as above. Chert, light- to medium-grayish-brown, fossiliferous and glauconitic; trace
2057 - 2073	Limestone and shale as above. Shale, red; trace. ORDOVICIAN AT 2669 FEET
	End of logged interval.

Lorain County
Henrietta Township
Lot 19

East Ohio Gas Co. #1
Reighley
Permit No. 892
Sample No. 1991
Elevation (KB) 834 feet

Depth (ft)	
720 - 750	Shale, medium-gray, calcareous, slightly fossiliferous
750 - 760	Shale as above. Limestone, medium-brown, fine-grained, argillaceous. DELAWARE LIMESTONE AT 760 FEET
760 - 770	Limestone, light-grayish-brown, fine-grained
770 - 780	Limestone, medium-brown, dense, very finely crystalline, fossiliferous. Chert, light-brown, fossiliferous; trace
780 - 790	Limestone as above, with brown micaceous flakes
790 - 800	Limestone as above. Limestone, light-brownish-gray, coarse-grained, very fossiliferous. COLUMBUS LIMESTONE AT 795 FEET
800 - 810	Limestone, light-gray and light- and medium- and grayish-brown, microcrystalline to very finely crystalline. Shale, dark-gray; trace
1595 - 1620	Dolomite, medium-brown and very light-brownish-gray, microcrystalline to very finely crystalline
1620 - 1633	Anhydrite. Dolomite, medium-brown, microcrystalline to very finely crystalline; trace
1633 - 1643	Anhydrite, 50-60%. Dolomite, light-grayish-brown, microcrystalline to very finely crystalline
1643 - 1651	Anhydrite and dolomite as above. Shale, medium-grayish-green, dolomitic; trace
1651 - 1660	Dolomite, medium- to dark-brown, dense to microcrystalline; anhydritic in part. Anhydrite, 10-20%
1660 - 1672	Limestone, very dark-brown, dense; dolomitic in part
1672 - 1685	Limestone as above. Limestone, dark-brown, blocky
1685 - 1693	Anhydrite, 70%. Dolomite, light-grayish-brown, very finely crystalline, anhydritic
1693 - 1704	Dolomite, medium-brown, very finely crystalline. LOCKPORT GROUP (GUELPH DOLOMITE) AT 1696 FEET
1704 - 1728	Dolomite as above, oil stain in small vugs. Dolomite, very light-grayish-brown, slightly sandy; sand fine-grained and subangular
1728 - 1755	Dolomite, light-yellowish-brown, medium-brown, and very light-brownish-gray, very finely to medium-crystalline; trace of oil stain as above and of asphaltic stain
1755 - 1762	Dolomite, light-yellowish-brown and light yellowish-gray, very finely to medium-crystalline; some intercrystalline and vuggy porosity
1762 - 1773	Dolomite as above. Dolomite, very light-gray, finely to medium-crystalline; good vuggy porosity
1773 - 1805	Dolomite as above, very light-gray and white, vuggy. GOAT ISLAND DOLOMITE AT 1800 FEET
1805 - 1813	Dolomite as above. Dolomite, very light-brownish-yellow
1813 - 1843	Dolomite, light-yellowish-brown, finely to medium-crystalline, silty to very silty; some vuggy and intercrystalline porosity. Chert, light-brown and brownish-gray; heavy trace. GASPORT DOLOMITE AT 1843 FEET
1843 - 1855	Dolomite, light-brown to yellowish-brown, finely to medium-crystalline. Chert, very light-brownish-gray; 10-20%
1855 - 1875	Dolomite, light- and medium-gray, medium- to coarsely crystalline. Dolomite and chert as above, trace
1875 - 1881	Dolomite as above. Shale, dark-grayish-brown, dolomitic. Pyrite, trace, in both dolomite and shale. ROCHESTER SHALE AT 1880 FEET
1881 - 1895	Dolomite, medium-grayish-brown, argillaceous and pyritic in part; coarsely bioclastic. Shale, dark-brown, dolomitic
1895 - 1903	Dolomite, very light-brown to yellowish-brown, microcrystalline to very finely crystalline, slightly glauconitic. Dolomite and shale as above. DAYTON FORMATION AT 1900 FEET
1903 - 1915	Dolomite, very light-greenish-yellow to yellowish-gray, finely crystalline, slightly glauconitic. Dolomite, medium- to dark-

brown, coarse-grained, fossiliferous. Chert, gray, fossiliferous; trace

810 - 820 Limestone, light- to medium-yellowish-brown, fine- to coarse-grained, fossiliferous. Chert, white, rough; trace

820 - 840 Limestone, light-brown, fine- to coarse-grained, fossiliferous; slightly argillaceous in part. Chert, white, fossiliferous; trace

840 - 850 Limestone as above, light-grayish-brown to medium-brown. Chert as above, trace

850 - 870 Limestone as above, light-brown

870 - 880 Limestone, light-brown and grayish-brown, fine-grained, fossiliferous. Chert, white and light-grayish-brown; heavy trace

880 - 900 Limestone as above. Chert, white and light-gray, fossiliferous and light-grayish-brown; 10%

900 - 910 Limestone, light-brown and light-grayish-brown, dolomitic, fine-grained and crystalline, sandy; sand fine-grained, subangular to subrounded. Chert, white, light-gray, and light- to medium-grayish-brown, dolomitic; trace

910 - 920 Limestone as above. Limestone, white, fine-grained, sandy; sand fine- and medium-grained, subangular to rounded

920 - 930 Limestone, medium-brown, dense, finely crystalline, lustrous

930 - 950 Limestone as above. Limestone, white and very light-brown, fine- to medium-grained. Chert, brown and white; trace

950 - 960 Limestone, light-gray and grayish- and light-brown, fine-grained and crystalline. Chert, white; trace

960 - 970 Limestone, white to very light-gray, fine-grained, fossiliferous, very sandy; sand angular and very fine-grained. Chert, white; 30%

970 - 980 Limestone as above. Limestone, light- to medium-brown. Chert as above. BOIS BLANC FORMATION AT 980 FEET

980 - 990 Dolomite, light-brownish-gray and grayish-brown, finely crystalline, very sandy, with good intercrystalline porosity; sand very fine-grained and angular. Chert, light-gray; with dolomite crystals; 40-50%

990 - 1000 Dolomite as above. Limestone, medium-brown, fine-grained and finely crystalline. Chert as above, fossiliferous

1000 - 1020 Dolomite and chert as in 980-990 foot sample; dolomite very slightly glauconitic

1020 - 1040 Chert, light-gray to white and brown, fossiliferous, 50-60%. Dolomite, light- to medium-brown, fine-grained and crystalline, sandy, very slightly glauconitic

1040 - 1050 Dolomite as above. Dolomite, light- to brownish-gray, microcrystalline. Chert, white and brown, fossiliferous, 30-40%. SILURIAN (RAISIN RIVER DOLOMITE) AT 1050 FEET

1050 - 1060 Dolomite, medium-brown, microcrystalline

1060 - 1070 Dolomite, light-gray and medium-brown, microcrystalline to very finely crystalline

1070 - 1080 Dolomite, medium-yellowish-brown and light-grayish-brown, microcrystalline; dolomite very slightly glauconitic

1080 - 1090 Dolomite, light-brown, microcrystalline

1090 - 1100 Dolomite as above. Dolomite, light- to medium-gray

1100 - 1110 Dolomite, light-grayish-brown, microcrystalline; anhydritic in part

1110 - 1120 Dolomite, light- to medium-brownish-gray, microcrystalline; argillaceous in part

1120 - 1130 Anhydrite, white and brown, crystalline and granular; 80%. Dolomite, medium-brown, dense and clayey to microcrystalline; 20%. SALINA GROUP (UNDIFFERENTIATED) AT 1128 FEET

1130 - 1150 Anhydrite as above, 60%. Dolomite as above, 40%

1150 - 1160 Dolomite as above; anhydritic in part; 70%. Anhydrite, 30%

1160 - 1170 Dolomite, light- to medium-gray; slightly greenish in part; and light and medium brown, dense, clayey; 80%. Anhydrite, 20%

1170 - 1190 Anhydrite, 50-60%. Dolomite as above, 40-50%

1190 - 1200 Dolomite, medium-brown, dense, clayey; anhydritic in part; 70-80%. Anhydrite, 20-30%

1200 - 1210 Dolomite as above, medium-gray and medium-brown. Anhydrite, 20%

1210 - 1220 Anhydrite and dolomite as above. Shale, medium-gray, slightly greenish, dolomitic; trace

1220 - 1230 Dolomite as above. Anhydrite, trace

1230 - 1250 Dolomite, light- and medium-brown and medium-brownish-gray, microcrystalline; clayey in part. Anhydrite, 30%

1250 - 1260 Dolomite as above. Anhydrite, heavy trace

1260 - 1280 Dolomite as above. Anhydrite, 30%. Shale, medium-gray, slightly greenish; trace

1280 - 1300 Dolomite as above. Anhydrite, heavy trace. Shale, trace

1300 - 1310 Dolomite as above, very anhydritic. Anhydrite, 10-20%

1310 - 1330 Dolomite and anhydrite as above. Shale, medium- and dark-gray; trace

1330 - 1340 Anhydrite, 80%. Dolomite, light-grayish-brown, microcrystalline

1340 - 1360 Dolomite as above. Dolomite, light- to medium-brown; clayey in part. Anhydrite, trace

1360 - 1370 Dolomite, very light-grayish-brown to medium-brown, dense to microcrystalline; clayey in part. Shale, light-grayish-green, dolomitic (grades into argillaceous dolomite); heavy trace. Anhydrite, trace

1370 - 1380 Dolomite and shale as above. Anhydrite, 10%

1380 - 1390 Shale grading into dolomite as above, grayish-green; 40%. Dolomite as above. Anhydrite, trace

1390 - 1400 Anhydrite, light-brown; 50%. Dolomite as above, 40%. Shale grading into dolomite as above, grayish-green; 10%

1400 - 1420 Dolomite, light- and medium-brown and greenish-gray, dense to microcrystalline; argillaceous in part. Anhydrite, heavy trace. Shale, dark-gray and greenish-gray; trace. Gypsum crystals, trace

1420 - 1430 Dolomite, gray and brown, dense to microcrystalline, argillaceous. Shale, light- to medium-grayish-green; trace. Anhydrite, trace

1430 - 1460 Dolomite, light-brown and light- to medium-gray, dense to microcrystalline. Shale, greenish-gray; heavy trace. Anhydrite, heavy trace

1460 - 1490 Dolomite, light-brown, microcrystalline. Shale as above, trace. Anhydrite, trace

1490 - 1500 Dolomite as above, light-brown and grayish-

brown. Chert, light-gray; trace

1500 - 1520 Dolomite, light-brown and gray, microcrystalline; slightly argillaceous in part. Anhydrite, trace

1520 - 1530 Shale, medium-greenish-gray, dolomitic. Dolomite, light- to very light- and medium-brown, dense to microcrystalline

1530 - 1560 Dolomite, light-yellowish-gray and grayish-brown to brown, microcrystalline; anhydritic in part. Shale as above, trace. Anhydrite, trace

1560 - 1590 Dolomite, light- and medium-brown and grayish-brown, dense, clayey, microcrystalline. Anhydrite, trace

1590 - 1600 Dolomite, medium-brown and light-gray, microcrystalline. Anhydrite, trace

1600 - 1610 Dolomite, light-grayish-brown, microcrystalline

1610 - 1620 Dolomite as above. Shale, dark-gray, dolomitic

1620 - 1630 Shale as above. Dolomite as above. Dolomite, medium-brown

1630 - 1650 Dolomite, light-grayish-brown to medium-brown, light-gray, and brownish-gray, microcrystalline; argillaceous in part. Shale as above, trace

1650 - 1660 Dolomite, light- to medium-brown, microcrystalline. Shale, dark-gray and greenish-gray, dolomitic

1660 - 1670 Anhydrite

1670 - 1680 Anhydrite. Dolomite, light-brown, microcrystalline; trace

1680 - 1690 Dolomite, light-grayish-brown, microcrystalline

1690 - 1700 Dolomite as above. Shale, dark-gray and black; 10%. Anhydrite, trace

1700 - 1710 Dolomite, medium-brown, microcrystalline; anhydritic in part. Anhydrite, heavy trace

1710 - 1720 Dolomite and anhydrite as above. Shale, dark-brownish-gray; trace

1720 - 1740 Limestone, medium- and dark-brown, dolomitic, dense. Limestone, light-brownish-gray, microcrystalline. Shale as above, trace. Anhydrite, trace

1740 - 1750 Dolomite, light- and medium-gray and brown, microcrystalline. Anhydrite, 5%. Shale, dark-gray; trace. LOCKPORT GROUP (GUELPH DOLOMITE) AT 1745 FEET

1750 - 1800 Dolomite, light- and medium-brown and yellowish- and grayish-brown, microcrystalline; asphaltic in part. Dolomite, light-medium-gray, microcrystalline, argillaceous; heavy trace. Anhydrite, trace. Limestone, brown, dense; as above; trace

1800 - 1820 Dolomite, light-yellowish-brown and light- and medium-brown, microcrystalline and finely crystalline

1820 - 1830 Dolomite as above. Anhydrite, heavy trace

1830 - 1840 Dolomite, very light-gray and very light-grayish-yellow, microcrystalline to medium-crystalline

1840 - 1860 Dolomite as above. Dolomite, light-yellowish-brown. GOAT ISLAND DOLOMITE AT 1860 FEET

1860 - 1870 Dolomite, very light-yellowish- to grayish-brown and gray, very finely crystalline, moderately silty. Chert, light-yellowish-gray, smooth; heavy trace

1870 - 1880 Dolomite as above. Chett as above. Chert, white, rough; 5%

1880 - 1890 Dolomite as above. Chert as above, 10%

1890 - 1900 Dolomite as above. Chert as above, heavy trace. GASPORT DOLOMITE AT 1900 FEET

1900 - 1910 Dolomite and chert as above; 10% of dolomite light- to medium-gray; trace glauconite in brown dolomite

1910 - 1930 Dolomite as above. Dolomite, light- and medium-gray; 50%. Chert and glauconite as above. ROCHESTER SHALE AT 1930 FEET

1930 - 1940 Dolomite, light- and medium-yellowish-brown, brown and gray, microcrystalline to finely crystalline. Chert, white and gray; trace

1940 - 1950 No samples. DAYTON FORMATION AT 1947 FEET

1950 - 1960 Shale, dark-brown and medium-grayish-green, dolomitic. Dolomite, light-gray and grayish-yellow and light-brown, very finely to finely crystalline. Glauconite pellets, coarse; trace. UNNAMED DOLOMITE AT 1958 FEET

1960 - 1970 Shale, dolomite, and glauconite as above. Shale, bright-medium-green; trace

1970 - 1980 Dolomite as above. Shale, medium-green; as above, trace. CABOT HEAD FORMATION AT 1974 FEET

1980 - 1990 Shale, medium-greenish-gray. Shale, red, very minor

1990 - 2000 Shale, greenish-gray; as above. Sandstone, light-olive- to greenish-gray, dense, slightly dolomitic; trace

2000 - 2020 Shale as above, in part dark- to reddish-brown; with heavy trace of sandstone. Dolomite, light-yellowish-brown and gray, microcrystalline to very finely crystalline; 50%. Sandstone, light-brownish-gray, dense, slightly calcareous; trace

2020 - 2030 Shale, medium-greenish-gray and brown. Sandstone as above, heavy trace

2030 - 2070 Shale as above, gray; 70%. Limestone and dolomite, light-yellowish-gray and gray and brown with yellow calcite crystals; fine- to medium-grained and finely crystalline. Hematite, heavy trace. Sandstone as above, trace. Limestone, dark-brown, dense, phosphatic; trace in 2060-2070 foot sample

2070 - 2080 Shale, medium-greenish-gray; 40-50%. Sandstone as above, 10-20%. Dolomite as above, 20-30%. Hematite, 10%

2080 - 2085 Limestone and dolomite, white, light-brownish-gray, slightly fossiliferous. Shale as above, 30%. Hematite, 10%. Sandstone, 5-10%

2085 - 2115 Limestone and dolomite as above, fine- to coarse-grained and crystalline. Glauconite, chert, and hematite, trace. Sandstone, trace. BRASSFIELD FORMATION AT 2088 FEET. ORDOVICIAN AT 2115 FEET

2115 - 2145 Shale, red, 30%. Shale, grayish-green, 30%. Dolomite and limestone as above. Chert, trace

End of logged interval.